# SEEDING PRAIRIE RANGELANDS

## A MANAGEMENT AND ECONOMIC GUIDE


ECONOMICS BRANCH — RESEARCH BRANCH
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# SEEDING PRAIRIE RANGELANDS - A MANAGEMENT AND ECONOMIC GUIDE

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## A MANAGEMENT AND ECONOMIC GUIDE

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SUMMARY

Recommendations are presented to guide farmers and ranchers of the Brown and Dark Brown soil zones in seeding ranges to improved forage species. Experiments have shown that such seedings will triple grazing capacity. But before investing money in an improvement project, the farmer or rancher must know whether it will pay.

The profitability of seeded pasture can be estimated by budgeting and by the use of valid economic principles. In budgeting, expected market returns to the rancher are compared with his costs of seeding.

Costs of seeding include: seedbed preparation, seeding, fencing, water development, nonuse and an interest charge on each cost. The initial investment in recent seedings in southwestern Saskatchewan and southeastern Alberta has ranged from $8.80 to $16.50 per acre, depending upon soil texture and the kind of machinery used. These costs did not include fencing, water development, or maintenance of fences or water facilities.

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Advantages of seeded pasture include: a tripling of grazing capacity, improved quality forage, increased rate of gain of animals and higher calving or lambing percentages. Returns are influenced by the rancher's management and by the success of the seeding project.

Seeding ranges to improved forage species is a good alternative to buying more rangeland to increase the farm grazing capacity. However, on the basis of average returns to pasture from the 1965-67 Alberta cow-calf enterprise analysis, neither of these practices will yield a market rate of return to investment. On the other hand, mid-1969 livestock prices are highly favorable to range seeding.

## INTRODUCTION

The rangelands of western Canada are located mostly within the semi-arid parts of the region. Native forage yields tend to be low and vary from about 330 pounds per acre in the drier parts of the Brown soil zone to about 600 pounds per acre in the moister parts of the Dark Brown soil zone.

Yields of various forages differ. Tame hay is about one and one-half times as productive as seeded pasture, which yields less because of trampling and the need to provide for carryover of forage at the end of the season. Seeded pasture is about three times as productive as native range, shown by the results of numerous grazing trials.

Although seeded pasture yields more than native range, relatively little of it has been developed. Thus, in western Canada, there are about 43.8 million acres of native range and only about 5.0 million acres of seeded pasture.

This bulletin outlines procedures for establishing and managing seeded pasture and examines the economics of converting native range to seeded pasture in the Brown and Dark Brown soil zones of the Prairie Provinces (Figure 1).


FIGURE 1 - BROWN AND DARK BROWN SOIL ZONES OF THE PRAIRIE PROVINCES OF CANADA

# ESTABLISHING AND MANAGING SEEDED PASTURES

## Site Selection

Land quality is of prime importance. The best available land should be chosen for conversion because it will give the greatest increase in returns. Steep slopes and stony, sandy, or saline soils will not produce as much herbage as better quality lands. Moreover, poor sites usually cost more per acre to develop than good sites.

Size and accessibility of the area are important in site selection. Calving and breeding fields should be easily accessible. Availability of water and ease of fencing should be considered.

## Land Preparation

The aim in preparing land for seeding should be to kill the native vegetation, thus making available to the seeded grass or legume more plant food, moisture, and sunlight. The effect of cultivation on the success of seeding is shown below:

| Cultivation | Grass stand obtained | |
|---|---|---|
| | (per cent) | (rating) |
| Plow and one-way | 75 | Excellent |
| One-way twice | 45 | Fair |
| One-way once | 35 | Fair |
| No cultivation | 10 | Poor |

Very heavy grazing for one or two years prior to seeding will weaken the native cover. Also, it may allow the use of other pastures to be deferred in anticipation of their being used more heavily while the seeded stand becomes established.

Methods

The native cover must be killed. The method used to destroy the native cover is not important but will depend on availability of machinery and cost. Machines commonly used are:

Rototiller. The machine covers the ground slowly but only one operation is necessary.

Heavy-duty cultivator with spikes. The machine is suited to heavy soils or stony areas. Two passes are made at right angles to each other and sometimes a third pass is made diagonally with wide shovels or with a disc implement. A discer or offset disc may be used for the final pass.

Disc equipment. These machines are suited to light soils and stone-free areas. Disc plows, heavy-duty discs, simple offset discs and serrated offset discs are in use.

Land may be prepared at any time of the year although the time of operation will affect the ease and cost of the work. Spring and fall are usually the best times as the ground is moist. A favored method of land preparation is heavy spring grazing, followed by late spring or early summer cultivation and fall seeding.

## Choice of Crops

Simple mixtures of a single grass plus alfalfa should be used for large-scale seedings of prairie rangeland in the Brown and Dark Brown soil zones.

Grass should not be seeded alone. Grasses seeded alone usually become sodbound after four or five years because of a lack of nitrogen. A mixture of grass and alfalfa will produce up to twice as much forage as grass alone. Here are two recommended mixtures:

1) Russian wildrye, 5 pounds and Rambler alfalfa, 1 pound.
2) Crested wheatgrass, 5 pounds and Rambler alfalfa, 1 pound.

Seeding rates differ with different row spacings. Several other grasses and legumes may be useful on cultivated lands in areas of low potential or in problem areas such as saline (alkali) locations. Consult a District Agriculturist or Agricultural Representative for advice on mixtures for such areas.

## Seeding

### Time of Seeding

Pasture mixtures should be seeded in the late fall or early spring. The fall seeding period starts in mid-October. Seeding may be continued after freeze-up if the soil is dry enough to allow the seed to be placed in the soil. Spring seeding should be done early, preferably before mid-May.

### Depth of Seeding

Failures in seeding pasture mixtures are most often caused by seeding too deep. On heavy-textured soils, the seeding depth should be less than one inch; on light-textured soils, it should not exceed

one and one-half inches. This is how depth of seeding affects the success of seeding:

| Grass | Seeding Depth | | | | | |
|---|---|---|---|---|---|---|
| | 1/2 inch | | 1 and 1/2 inches | | 3 inches | |
| | per cent stand | rating | per cent stand | rating | per cent stand | rating |
| Crested wheatgrass | 90 | Excellent | 45 | Fair | 0 | Nil |
| Russian wildrye | 95 | Excellent | 75 | Good | 0 | Nil |

Method of Seeding

Any implement that can put seed in the ground at a uniformly shallow depth and do so rapidly is suitable. Depth control devices (Figure 2), which pack the soil are available for the standard double disc drill or can be made. Their use is recommended because packing of the soil is necessary for success in seeding. Usually a discer will not do a satisfactory job of seeding pasture mixtures. Broadcasting is not recommended.

Row Spacing

Widely spaced rows are more productive than narrowly spaced rows. Pasture seedings should be in rows spaced from 12 to 24 inches apart. Weeds may be a problem in the first few years in the 18- to 24-inch spacings. Modern seed drills allow a spacing of 14 inches, a compromise, although an 18-inch spacing is better.

Seeding Rate

Five pounds of grass seed and one pound of Rambler alfalfa per acre are sufficient for 14-inch row spacings; less seed per acre

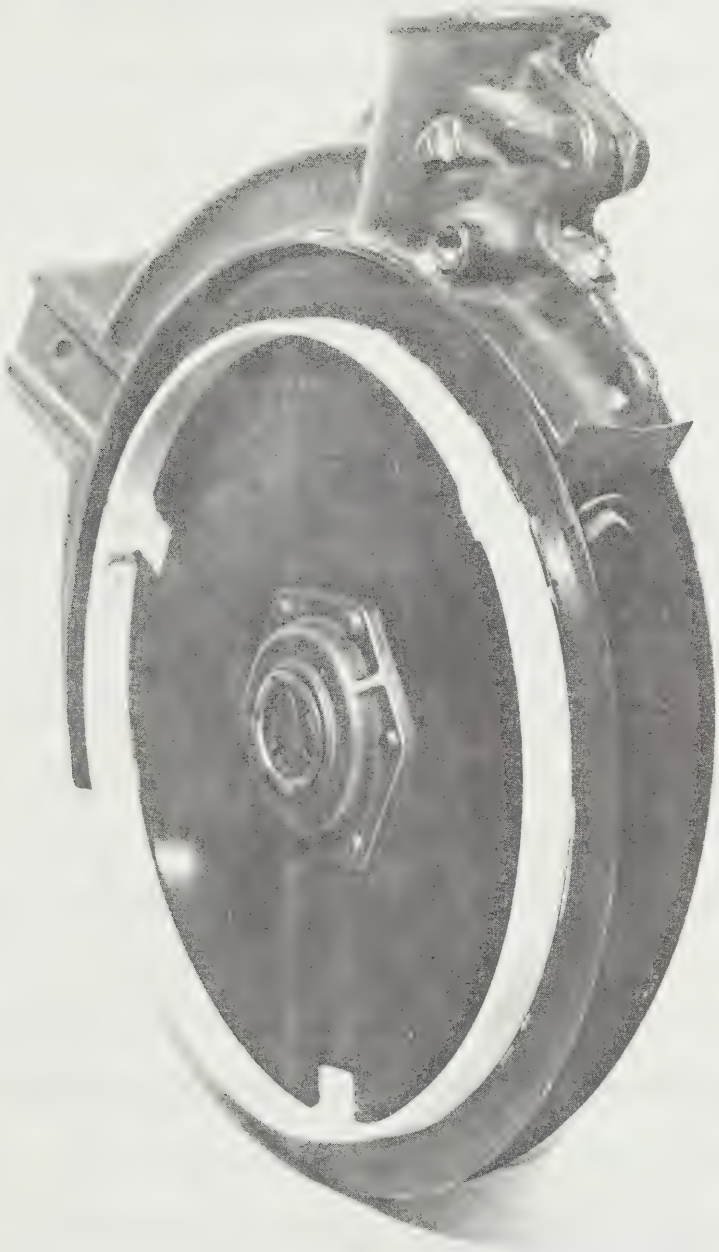

FIGURE 2 - SEEDING DEPTH CONTROL DEVICE

is needed for wider row spacings. As a general guide, the seeding rate will be correct if the drill is set to sow about three pecks of wheat. The rate of seeding can be checked by seeding for a short distance on a smooth road or other hard surface. There should be from 25 to 35 seeds per foot of row.

## Companion Crops

Cereals, such as wheat, oats, barley, or rye, are sometimes sown as 'companion' or 'nurse' crops. They do not help the forage crop and, if seeded heavily, are harmful. A light seeding of a cereal (2 to 3 pecks per acre) may be used if moisture conditions are good or if soil drifting is a problem. If used, cereals should be seeded separately. Rows of the cereal crop may either be sown to alternate with the rows of the forage crop or at right angles to them.

## Risk of Seeding Failure

Occasionally, all or part of a seeding may fail. Usually the reasons are: too deep seeding, grasshopper damage, or drought. But if recommendations are followed, the risk of seeding failure is minimal in the Brown and Dark Brown soil zones of western Canada. Recommendations include:

Seed the best sites first.
Kill the competing vegetation.
Seed before the season of most rainfall.
Use adapted forage crops.
Do not graze a new stand until it is established.

Farmers and ranchers are often hasty in assuming that a seeding of cultivated grasses is a failure. It may be two years before

the success of a stand can be determined. Obtain competent advice before reseeding or cultivating.

## Management

### After Seeding Protection

Only under very unusual circumstances should a seeded pasture be grazed in the seedling year. Thus, the land will be out of production for two years, that is, the year in which it is broken (and seeded, if fall seeded) and the seedling year. In the third year, production will range from that of native range upwards to three times this amount. By the fourth year, production should equal that expected from seeded pasture.

### Date of Spring Use

Spring use should be delayed until the grass has made at least 5 inches of growth. This will seldom be before April 15 in the southern part of the plains or May 15 in the northern part.

### Intensity of Grazing

Seeded pasture should be used heavily. Seventy per cent of the annual herbage production can be used. After grazing, the stubble should be no more than 3 inches in height. There should be no unused areas or ungrazed plants.

### Grazing Systems

Grazing systems should be simple. One pasture for each season is sufficient. If only one seeded pasture is available, it

should be used as spring pasture. Russian wildrye pasture can be used as spring pasture or as fattening pasture in September and October or as maintenance pasture after October.

Grazing systems include the Rotation-Free Choice system. In this system, seeded pasture should make up a minimum of 20 per cent of the pasture acreage. The seeded pastures should be fenced separately. Seeded pasture is used alone in spring and both seeded pasture and native range are used in summer. With 20 per cent seeded pasture, the system will allow about 35 per cent more intensive use than with native range alone.

A simple system is one that uses crested wheatgrass or Russian wildrye pasture in the spring and native range in the summer. Forage yields are higher, because, for maximum production, native range should not be used before mid-June.

## Mowing

Seeded pasture should not be expected to produce hay. But it should be kept free of old growth, especially if it is patchy. Hay may be cut in years of above-normal rainfall when the pasture produces forage in excess of that needed by livestock. If part is cut, care should be taken the following year to ensure that livestock do not use only the hayed area and undergraze the rest of the pasture.

## ECONOMICS OF CONVERSION

The determination of the economics of seeding rangeland requires an analysis of costs and returns.

### Costs

Costs include: seedbed preparation, seeding, fencing, water development, lost grazing during establishment period or nonuse, and an interest cost on each of these.

In the 1960's, range seeding costs varied from $8.80 to $16.50 per acre for breaking, seedbed preparation, seed, and seeding. The higher costs within this range were on heavier-textured soils.

Costs of cultural operations may be obtained from the publication, Agricultural Machinery Costs[1]. Some examples are:

| Machinery Used | Average cost per acre |
|---|---|
| Rototiller | $10.60 |
| Heavy-duty cultivator | 6.00 |
| Offset disc - light | 6.50 |
| - heavy | 9.00 |
| Seed drill | 2.25 |

Fences are needed to protect the seeded area during establishment. Costs per acre depend on the size and shape of the field, use of existing fences, supplementary benefits provided by a new fence, and salvage value. For example, at $800 per mile of fence, costs are $10 per acre for a quarter-section, $7.50 per acre for a

[1] Thompson, J.L., Agricultural Machinery Costs, Publication 1291, 1966. Information Division, Canada Department of Agriculture, Ottawa.

half-section, $5 per acre for a section, or $3.75 per acre for two sections in a block. Fencing costs are an important item and vary between farms.

Carrying capacity of the seeded range likely will be tripled and existing stock watering facilities may not be adequate. The need for, and cost of, additional facilities will vary between and within farms.

Lost grazing time or nonuse may be overcome by renting pasture, heavy stocking of other pastures, buying or producing more feed, or adjusting numbers of cattle, or by a combination of these. Cost of nonuse is determined by preparing a simple partial budget. If pasture is rented, cost of nonuse is based on the cost of renting. But if cattle numbers are reduced, a more detailed partial budget will be needed.

Costs and benefits must be brought to a common time base if they are to be compared. This is because a dollar spent last year is not the same as a dollar spent today; interest costs must be added. A dollar received next year is not the same as a dollar received today because today's dollar can be invested for a year, whereas next year's dollar must be discounted.

The foregoing points are illustrated in Table 1, which shows range improvement costs for an imaginary ranch where 600 acres were broken and seeded to an improved grass-alfalfa mixture. Costs were calculated on an acre basis but could be calculated on a project basis. Costs are shown as they were in the fall of the year after seeding. (This year is called year "t", the previous year is year "t - 1", and the following

TABLE 1 - A SUMMARY OF RANGELAND IMPROVEMENT COST FOR AN IMAGINARY RANCH, IN DOLLARS PER ACRE

| | Year | Initial cost | Cost at year "t" | | | |
|---|---|---|---|---|---|---|
| | | | At 6 per cent | | At 8 per cent | |
| | | | Interest | Total | Interest | Total |
| Breaking | t - 1.5 | 6.25 | .56 | 6.81 | .75 | 7.00 |
| Seeding | t - 1 | 5.20 | .31 | 5.51 | .42 | 5.62 |
| Fencing costs | t - 1 | 2.67 | .16 | 2.83 | .21 | 3.04 |
| Salvage value | t | -1.00 | 0 | -1.00 | 0 | -1.00 |
| Stock - water development | t | 0 | | | | |
| Grazing loss (nonuse) | t - 1 | .42 | .03 | .45 | .04 | .46 |
| Grazing loss (nonuse) | t | .42 | 0 | .42 | 0 | .42 |
| Grazing loss (nonuse) | t + 1 | .42 | -.02 | .40 | -.03 | .39 |
| Total with 2 years' loss of grazing | | | | 15.02 | | 15.54 |
| Total with 3 years' loss of grazing | | | | 15.42 | | 15.93 |

year is year "t + 1", etc.).

The range was broken at a cost of $6.25 per acre. To this cost was added 1.5 years of interest. The breaking was seeded in the fall and one year of interest was added to the cost of seeding. Two miles of fence, costing $800 per mile, were needed to protect the seeding. Thus, the cost per acre for fencing was $1600/600 acres = $2.67. One year of interest was added to the cost of fencing. (The fence did not serve any other use and the whole cost was charged to the range improvement project. After the grass-alfalfa mixture had become established, the fence was salvaged at a value of $300 per mile.)

In the example, stock watering facilities were adequate for the increased number of cattle to be grazed.

To estimate cost of nonuse, the value of an animal unit month of grazing (AUM) must be known. For example, net pasture returns per cow wintered in cow-calf operations in the Brown and Dark Brown soil zones of Alberta averaged $14.80 for the three-year period of 1965-67 inclusive.[1]

Each cow-calf unit consisted of 8.2 animal unit months of grazing in a six and a half month grazing season. (An animal unit month of grazing consists of grazing one cow for one month or its equivalent.) Thus, the value of pasture was $14.80 per cow-calf unit divided by 8.2 AUM per cow-calf unit, that is, $1.83 per AUM.

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[1] Hackett, B.A., 1965-67 Alberta Cow-Calf Enterprise Analysis, Alberta Department of Agriculture, Edmonton, Alberta, mimeo. For these three years, these farmers received an average price of $24.21 per 100 pounds for their calves. This is much lower than prices in mid-1969.

If we assume a carrying capacity of 4.25 acres per AUM[1], the value of rangeland is $1.83 per AUM divided by 4.25 acres per AUM, that is, $0.42 per acre. Interest was charged on the cost of nonuse.

## Benefits

Benefits are difficult to estimate because they involve the complex conversion of range forage to animals to dollars. Many uncontrolled physical and economic factors may affect each change.

An evaluation of increased returns from rangeland seeding depends on the:

Increase in grazing capacity of the seeded pasture over that of the original native range;

Duration of increased grazing capacity;

Year-to-year variability in increased grazing capacity;

Higher calf weaning weights resulting from better quality pasture;

Monetary value of the increased grazing capacity.

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[1] Acreage requirements per animal unit month differ in different regions. Examples from several areas in the Brown and Dark Brown soil zones are:

| | Manyberries, Alta. | Val Marie, Sask. | Swift Current, Sask. | Compeer, Alta. |
|---|---|---|---|---|
| Acres per AUM | 4.5 | 3.5 | 2.8 | 2.2 |
| Calculated value of rangeland in dollars | 0.40 | 0.52 | 0.64 | 0.82 |

The value of an increase in grazing capacity can be obtained by:

Estimating the increased value of the livestock pastured;

Determining the increased net income per acre by setting up a partial budget for the change in the livestock enterprise resulting from the increased grazing capacity; or

Determining the value of the increased grazing capacity at the cheapest alternative, i.e. by buying or leasing grazing land.

Three examples of the second method follow. This requires a partial budget. This budget should include the additional annual receipts expected, additional annual costs expected (but not including the pasture improvement costs), reduced annual receipts expected and reduced annual costs expected resulting from the change in the livestock enterprise. The difference between the returns and costs divided by the acres of pasture seeded shows the increased income per acre seeded.

Example 1

If seeding triples the grazing capacity and the additional net returns to pasture (as estimated from partial budget calculations) remain constant at $0.423 per acre of native rangeland (page 17) then the increased return from seeding is $1.27 minus $0.42, or $0.85 per acre ($0.423 x 2). (Since this value is a multiple of the value of native rangeland grazing, it illustrates the importance of seeding the best rangeland first.) The present value of a flow of income per year of $0.85 per acre depends on the interest rate and on the number

of years that this income is received. The value of such income flow for 5 time periods and 2 levels of interest rate (6 and 8 per cent) is shown in Tables 2 and 3. For example, the value of an income flow of $0.85 per acre for 20 years at 8 per cent interest is $8.34 (Table 3).

Example 2

Seeding to improved grass-alfalfa mixtures not only improves the grazing capacity but also results in increased livestock weight gains. The average rate of increase is about 9 per cent. If benefits per cow-unit are also increased by 9 per cent, then the increased income flow per acre of seeded pasture is $0.423 x 2.27 = $0.96. The 2.27 factor consists of the 2 extra head grazed when the grazing capacity is tripled plus an additional 9 per cent (.09) of benefit for each of the three head grazed. The present value of an income flow of $0.96 per acre for 5 time periods and 2 rates of interest is shown in Tables 2 and 3.

Example 3

The value of additional grazing capacity may differ between operators. For example, a study[1] reported that the residual return to pasture for the one-third of operators with the lowest cost was $27.59 per cow-unit per year. This is the same as a pasture return of $0.78 per acre. Adjusted for higher gains and a tripling of grazing capacity, this would result in an increased income of $0.78 x 2.27 = $1.77 per acre.

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[1] Hackett, B.A., 1965-67 Alberta Cow-Calf Enterprise Analysis, Alberta Department of Agriculture, Edmonton, Alberta, mimeo.

TABLE 2 - THE PRESENT VALUE OF FOUR ESTIMATES OF FUTURE GRAZING RETURNS FOR FIVE TIME PERIODS AT SIX PER CENT INTEREST, IN DOLLARS PER ACRE

| Grazing return | Time period in years | | | | |
|---|---|---|---|---|---|
| | 10 | 15 | 20 | 25 | 30 |
| | dollars per acre | | | | |
| .85 | 6.26 | 8.26 | 9.75 | 10.87 | 11.70 |
| .96 | 7.08 | 9.32 | 11.01 | 12.27 | 13.21 |
| 1.77 | 13.03 | 17.19 | 20.30 | 22.63 | 24.36 |
| 2.45 | 18.03 | 23.79 | 28.10 | 31.32 | 33.72 |

TABLE 3 - THE PRESENT VALUE OF FOUR ESTIMATES OF FUTURE GRAZING RETURNS FOR FIVE TIME PERIODS AT EIGHT PER CENT INTEREST, IN DOLLARS PER ACRE

| Grazing return | Time period in years | | | | |
|---|---|---|---|---|---|
| | 10 | 15 | 20 | 25 | 30 |
| | dollars per acre | | | | |
| .85 | 5.70 | 7.28 | 8.34 | 9.07 | 9.57 |
| .96 | 6.44 | 8.22 | 9.42 | 10.25 | 10.81 |
| 1.77 | 11.88 | 15.15 | 17.38 | 18.89 | 19.93 |
| 3.27 | 21.94 | 27.99 | 32.11 | 34.91 | 36.81 |

The present value of such an income stream is shown in Tables 2 and 3.

The benefits of increased grazing capacity can be evaluated also in terms of having to supply the grazing by alternative methods, for example, by purchasing or leasing additional grazing land. Data on 1968 sales and information from published reports[1] indicated that the market value for semi-arid native range in the Brown soil zone was approximately $18 per acre. (Higher values prevailed in the Dark Brown soil zones.) At 6 per cent interest this presented a net benefit return of 6/100 x 18 = $1.08 per acre. At 8 per cent interest the value was $1.44 per acre. If this is the benefit from native range, then the net benefits from seeded pasture should approximate 2.27 x $1.08 = $2.45 per acre for a 6 per cent interest rate and 2.27 x $1.44 = $3.27 per acre for an 8 per cent interest rate. The present value of these income streams, $2.45 and $3.27 per acre, are shown in Tables 2 and 3, respectively.

## Cost-Benefit Summary

Costs and benefits must be compared to complete the economic analysis. Depending upon which interest rate is used, this can be done by comparing the costs in Table 1 with the benefits summarized in Table 2 or 3. At 6 per cent interest, it would take an increased grazing return of $0.96 per acre over 30 years to recover range improvement costs. This was true with either two years or three years of nonuse. With an increased grazing return of $1.77 per acre, it

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[1] Cattle Ranching in Southern Alberta Family Operated Commercial Cattle Ranches Foothills and Shortgrass Regions, Publication No. 68/3, Economics Branch, Canada Department of Agriculture, Regina, Saskatchewan.

would require approximately 13 years to recover improvement costs with interest rates at 6 per cent and approximately 16 years with interest rates at 8 per cent.

## Economic Summary

The critical economic factors in conversion of range to seeded pasture are seedbed preparation costs, seeding costs, fencing requirements, and the benefits of the additional grazing capacity to the farm or ranch operator.

The level of benefits per acre from rangeland seeding depends upon the additional return to grazing per cow-unit and the carrying capacity. Rangeland seeding can be recommended where expected additional returns to pasture per cow-unit is above the average (Example 3 on page 18), or expected additional returns to pasture per cow-unit are at average levels ($14.80 per cow-unit) and the native grazing requirements per AUM is below 2.8 acres. Where the choice of increasing grazing capacity is between buying additional grazing land at the prices quoted in this publication and improving existing grazing facilities, the second alternative is the better one.

Every operator who considers range improvement by seeding of grass-alfalfa mixtures must budget his own situation. He must determine the expected returns to pasture from additional grazing land of the same grazing capacity. The benefits from the seeding of improved grass-alfalfa mixtures can be expected to be 2.27 times this amount.

Depending upon the interest rate to be used, the information in Figure 3 or 4 can be used to evaluate such a stream of benefits. Individual costs (Table 1) should be calculated for the proposed improvement project. The cost per acre may be drawn as a horizontal line on Figure 3 or 4. The point where the line crosses the benefit curve will show the number of years needed to recover the project investment.

The price level of goods and services purchased by farmers and livestock prices have increased since 1965-67. A selling price of $27.18 per 100 pounds for calves compared to $24.21 per 100 pounds received in the 1965-67 period[1] would be needed in 1969 to cover increased costs and still leave a net return to pasture of $14.80 per cow-unit. A selling price of $31.11 per 100 pounds would double the net return to pasture. Farmers must base their decision on current and expected future price levels. The present level of livestock prices is highly favorable to range seeding.

There is neither a general nor a simple answer to the question of whether or not to seed. Each farmer or rancher must analyse his own situation and then must decide for himself. The decision will be based on the costs of seeding and the expected returns from seeding. A comparison of these data will indicate if the proposed seeding project will be profitable or if it will result in financial loss.

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[1] Hackett, B.A., 1965-67 Alberta Cow-Calf Enterprise Analysis, Alberta Department of Agriculture, Edmonton, Alberta, mimeo.

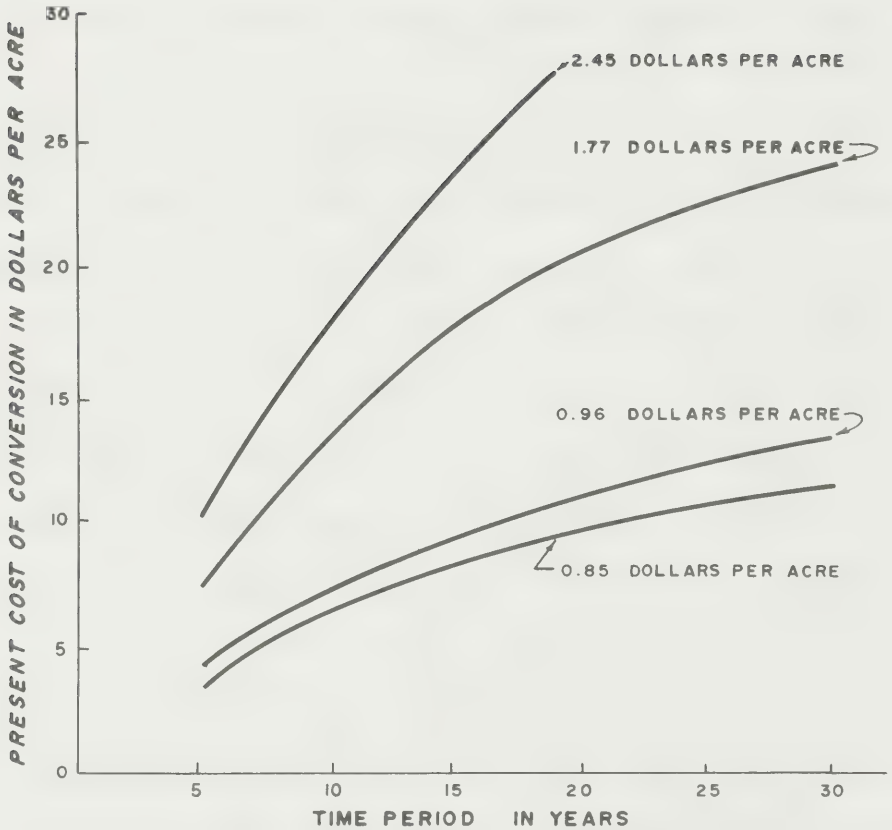


FIGURE 3 - YEARS REQUIRED TO RECAPTURE RANGELAND SEEDING COSTS OF FOUR LEVELS OF GRAZING RETURNS, DISCOUNTED AT SIX PER CENT

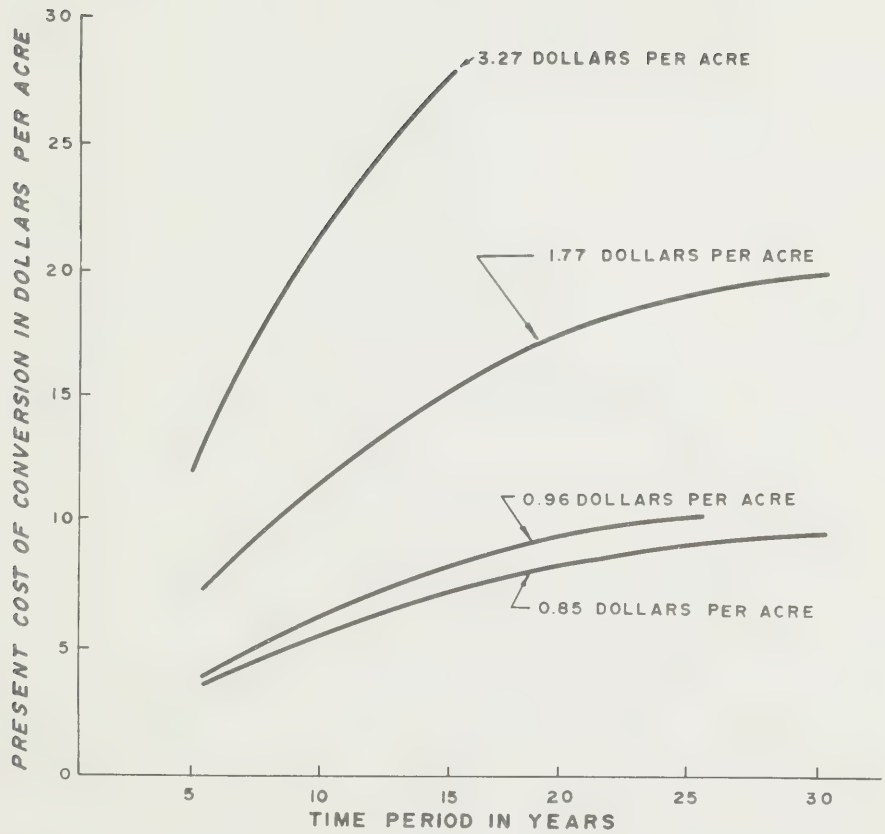


FIGURE 4 - YEARS REQUIRED TO RECAPTURE RANGELAND SEEDING COSTS FOR FOUR LEVELS OF GRAZING RETURNS, DISCOUNTED AT EIGHT PER CENT